Volume 38 March, 1952 *Number 3*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication Progress in the Textile Industry

TEXACO

REG. T. M.

PUBLISHED BY

THE TEXAS COMPANY

TEXACO PETROLEUM PRODUCTS

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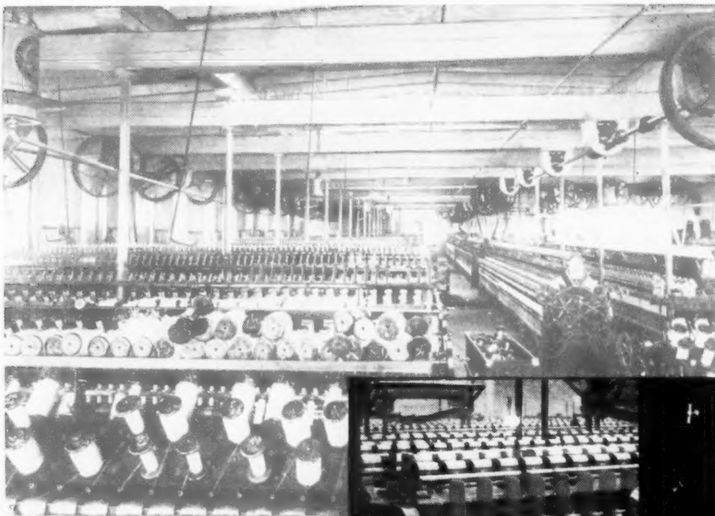

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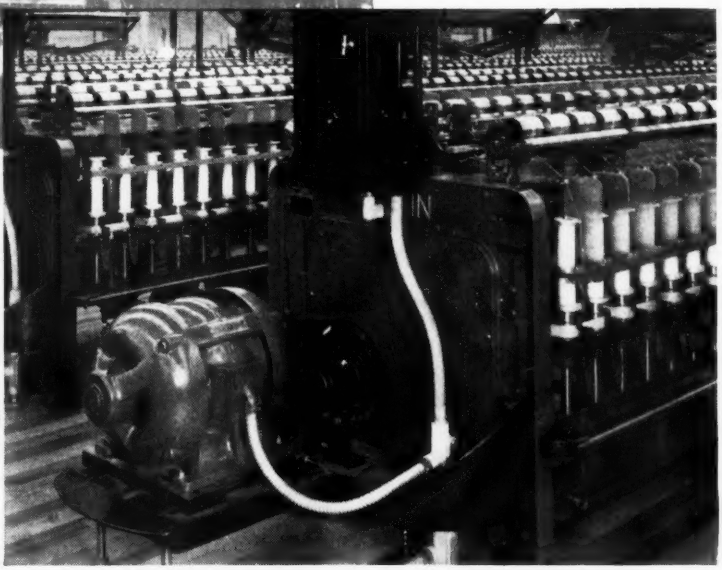

LOOKING AHEAD WITH TEXTILES

The arts of spinning, weaving and knitting are as old as civilization itself. Machines, of course, long ago replaced the human hand in the mass production of thread and cloth, but basic principles have remained the same.

Thus, the advances in textile manufacture over the past fifty years have been mainly improvements. Marvelous new synthetic fibres have been developed . . . mill layouts made more efficient . . . machines refined and speeded up . . . lubricants and lubrication methods improved. As individual electric motors, for example, replaced old-fashioned belt drives, better lubricant quality and greater lubrication know-how had to be developed.

That is why, during this half-century of betterment, Texaco Lubrication Engineers have kept their eyes peeled to anticipate the needs of the growing textile industry. As new methods and machines have been adopted, Texaco has been ready with specific lubricants to assure their best performance. Just so, Texaco will be ready for whatever developments the next fifty years may bring.

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FOR THE TEXTILE INDUSTRY

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LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

Published by

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Vol. XXXVIII March, 1952 No. 3

Lubrication Progress in the Textile Industry

THE STORY of spinning and weaving is extremely interesting because the art dates back to the beginning of civilization — it is one of the oldest handicrafts. Mechanization, however, started only about 200 years ago and the real growth of the Textile Industry has taken place within that span of time. Modern productivity in this industry is a result of the effort over the past half century to reduce costs through minimization of friction, wear, vibration, power consumption, and stock spoilage. This effort, of necessity, has required the cooperation of the textile machinery builders, the bearing manufacturers and the petroleum industry, as well as the mill operators.

Machine Design

The machinery builders, in their modern designs, have extended the use of anti-friction bearings, and porous metal bearings, and have provided for wider use of centralized, force feed, or automatic lubrication. In many instances, they also have replaced cast iron parts with steel precision parts, and have incorporated better bracing. These are all factors which contribute to more dependable operation and lower maintenance costs when the machinery is adequately lubricated with proper lubricants. Lubrication plays an extremely vital role when precision machinery is involved.

Plus Lubrication

The Petroleum Industry's contribution has consisted of stimulating the interest of both the mill operators and the machinery manufacturers in the more careful selection of lubricating oils and greases, as well as means for more positive application of such lubricants. In doing this, it has followed closely the trends in mill operation and machine design to keep abreast of changes that might affect lubricant requirements. Frequently, these necessitate the development of specialized lubricants to give the moving parts the added protection necessary for more dependable operation.

Today, lubrication in the Textile Industry bears no resemblance to the old expression, "The sqeaking wheel gets the grease," because:

a. The machinery builders plan, even on the drawing board, for positive, protective lubrication;

b. The machinery operators realize that the quality lubricants required for proper protection are relatively cheap when compared to the cost of the investment to be protected;

c. The Petroleum Industry, through its greater familiarity with textile mill operating conditions, has developed lubricants having the specific characteristics needed to meet these conditions.

Leads to Good Maintenance

In a modern textile mill, practically every process is a preparatory one for some subsequent process. This necessitates that all the machinery must be properly maintained and lubricated to avoid costly shut-downs and to assure continuous production. The details in regard to the types of lubricants re-

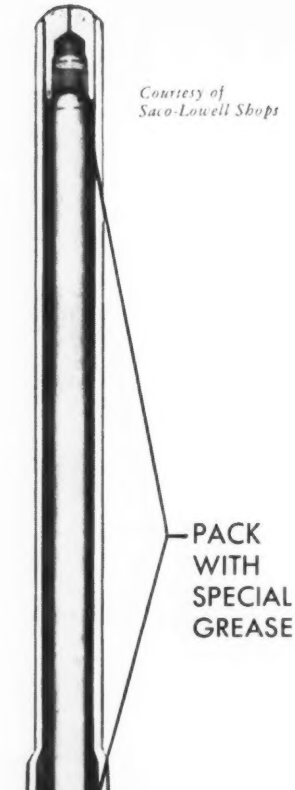


Figure 1—Constructional details of the Saco-Lowell New Era spindle, oil cushion type. Red indicates provisions for lubrication.

quired for the proper protection of the machinery, as well as their proper application ("how much" and "how often"), are studied by the bearing manufacturers, the machinery builders, and the lubrication engineers. Their recommendations should be followed.

Effective lubrication requires the correlation of the operating conditions and features of construction with the characteristics of the lubricant, both physical and chemical. In other words, lubricants, like machinery, must be designed to meet the requirements of the application. The trend toward greater precision in modern textile machinery to permit more dependable operation and increased production has placed more and more emphasis on the necessity for such correlation. Today, bearings are designed to retain lubricants more effectively. As a result, lubricants are called upon to provide full protection over longer periods of service and, at the same time, reduce power consumption which is a major cost item in mill operation. This means that in selecting lubricants, the chemical properties must be considered. For example, oxidation resistance, which has long been recognized as a primary requirement in spindle oils, now also is considered an important property of other lubricants used in the textile field, such as ball and roller bearing greases. Another property that has gained in importance and must be built into the lubricant is rust prevention. This characteristic is a major factor where machines operate under highly humid conditions; it is very important when highly finished steel working surfaces are involved.

SPINDLE LUBRICATION

Most spindles in operation today are still oil lubricated, although an appreciable number equipped with prepacked, grease-lubricated ball bearings are in use. The selection of a spindle oil, therefore, is still a major problem to mill management for spindle operation is important, not only because it affects the quality of the yarn, but because it also affects power consumption, an item which has such an important relation to production cost. An individual spindle consumes relatively little power but when thousands of spindles are being operated, the combined power consumption becomes a sizable item. The spinning rooms of most mills use about 60 per cent of the total power consumed and the greatest portion of this power is required for the spindles themselves.

Factors in Selecting Spindle Oils

At one time, spindle oils were selected on the basis of viscosity alone, because of its relation to power consumption. The trends toward higher speeds and larger packages, however, required that

Courtesy of Universal Winding Company

Figure 2 — Details of a high-speed "Uniflex" roller bearing uptwister spindle. This design is unique in that it contains no free oil and is lubricated only once a year. The bearings receive lubrication by seepage of oil from oil-soaked felt rings through porous bronze bushings.

the oil serve as a shock-absorbing medium to prevent hunting or vibration, as well as an effective lubricant for preventing wear and reducing power consumption. Study and experience has shown that performance in this respect can only be obtained with an oil having the following properties:

a. High resistence to oxidation
b. Low vaporizing tendencies
c. Negligible corrosive tendencies

Effects of Oxidation

Oxidation of petroleum oils results in increase in viscosity, eventual production of gummy, varnish-like materials, and increase in corrosive tendencies—all factors which would have a detrimental effect on the proper functioning of spindles, as well as their power requirements. The loss of light fractions through vaporization also results in an increase in viscosity.

It can readily be seen that oils must have the above-mentioned characteristics to avoid increased friction, excessive spindle wear, excessive power consumption, and the eventual necessity of thoroughly cleaning oil ports, reservoirs and bases.

Refinery Procedure

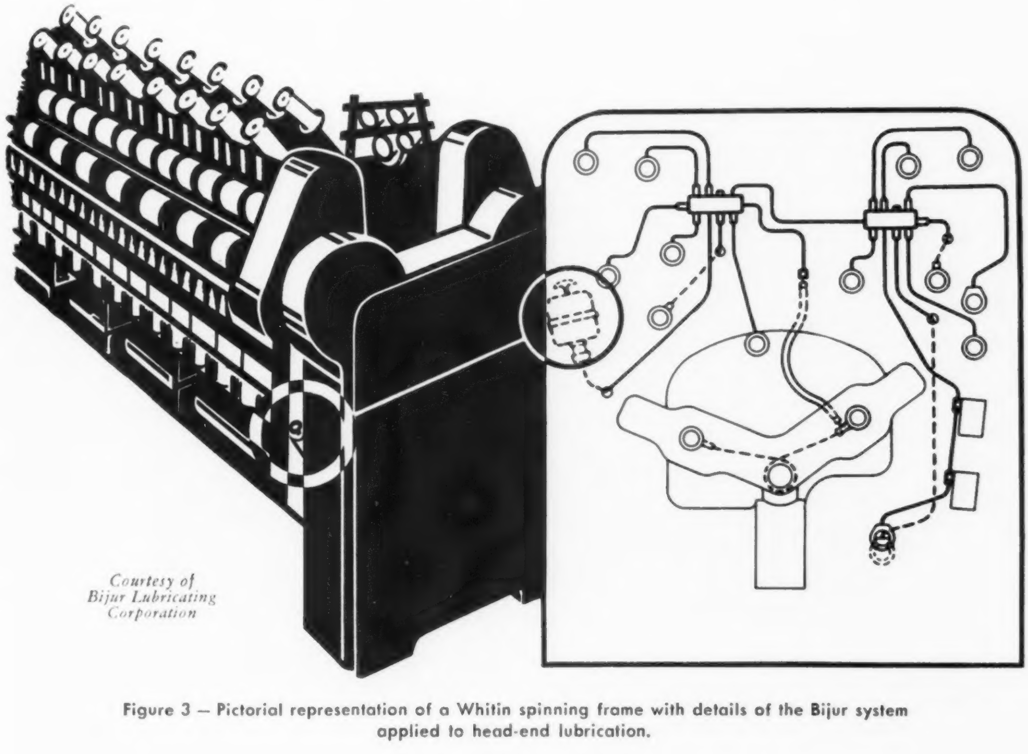
Petroleum research has made available to the mill operator special spindle oils having those characteristics required for long-time, trouble-free performance. The desired properties in these oils are achieved during their manufacture by

a. Selection of stocks having inherently good oxidation resistance;

b. Removal of those constituents most susceptible to oxidation, by means of suitable refining methods, to further increase oxidation resistance; and

c. Use of close fractionation when obtaining the desired viscosity in order to eliminate the more readily vaporized hydrocarbons.

Recently, the Petroleum Industry has been investigating the application of additive type oils for spindle lubrication in order to provide even better quality and performance than now available in premium spindle oils. As their description implies, these oils contain specially selected chemical compounds as added materials. The reason for their addition is to impart to the oil certain properties such as greater oxidation resistance, corrosion prevention, and rust prevention. The performance of additive oils developed for applications in other fields has proven their superiority over well-refined, straight mineral oils and has justified their slightly higher cost. There is reason to believe that this will also be the case with additive type spindle oils and it is very probable that the future will see increased usage of such oils.



Courtesy of Bijur Lubricating Corporation

Figure 3 — Pictorial representation of a Whitin spinning frame with details of the Bijur system applied to head-end lubrication.

Research Study

Numerous power breakdowns or analyses have been made in the past using an entire spinning frame, but very little information has been presented as to the requirements of a single spindle, due probably to the difficulty in accurately measuring the small amounts of power required by a single spindle in on-the-spot mill service. Some interesting results were obtained in a rather recent investigation* directed toward determining the effects of spindle speed, size of package, and lubricant on the power consumption of a conventional type spindle with a cast-iron bolster and oil reservoir. This study, which employed the apparatus shown in Figures 4 and 5, consisted of determining by means of a dynamometer the power requirement at a tape tension of 1 lb. when operating at four speeds ranging from 4,000 to 9,000 r.p.m. with each of five oils, ranging from 70.8 to 216 seconds in Saybolt Universal Viscosity at 100° F., and each of four standard spinning bobbins varying in package size from zero to 100 per cent full.

Power requirements ranged from 3.8 watts at 4,000 r.p.m. with the empty bobbin and the lowest viscosity oil to 33.6 watts at 9,000 r.p.m. with the full package and the highest viscosity oil. Tables I, II and III show the percentage increase in power requirements resulting from increase in spindle speed, package size, and oil viscosity, respectively. As indicated by these tables, this investigation showed that:

a. The power required for driving the spindle increases with speed.

b. The power required for driving the spindle increases with size of package.

c. The effects of speed and size of package on power requirement are interrelated and difficult to separate.

d. The effect of speed on power increases as package size increases and, also, the effect of package size increases as speed increases.

e. The power required for driving the spindle increases with increase in oil viscosity.

Other points of interest brought out by the results of this investigation are:

1. Power reductions by using lower viscosity spindle oils are worth-while and represent one of the simplest methods of reducing power costs.
2. A spindle dynamometer has definite application in the studying of comparative power requirements of different types of spindles; power requirements of spindles for changes in speed and weight and size of package; and optimum oil viscosities for the lubrication of spindles.

*"Lubrication and Power Characteristics of the Textile Spindle," a thesis prepared by Robert Lee Newell based on research carried out at Georgia Institute of Technology under a fellowship sponsored by The Texas Co. and directed by Professor R. L. Allen.

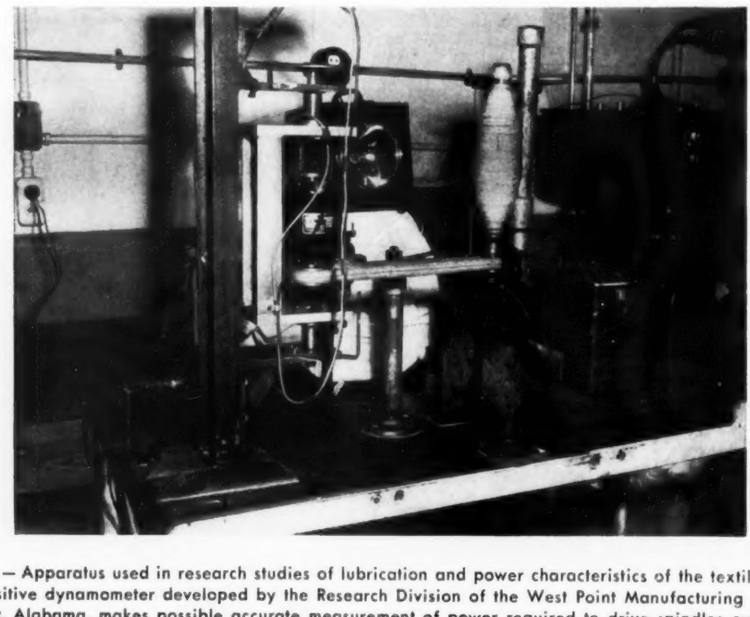


Figure 4 — Apparatus used in research studies of lubrication and power characteristics of the textile spindle. This sensitive dynamometer developed by the Research Division of the West Point Manufacturing Company, Shawmut, Alabama, makes possible accurate measurement of power required to drive spindles over a wide range of speeds. These latter are taken by a stroboscope and checked by a hand tachometer.

Figure 5 — Spindle, bobbins, oil reservoir and bolster used in research studies employing apparatus shown in Figure 4.

3. Changing spindle oil after the break-in period is advisable to remove abrasive material.
4. Oil throw does not occur with spindles that do not wobble if proper oil level in the reservoir is maintained.
5. Oil temperatures are poor criteria for proper oil viscosities in textile spindles and show only extreme conditions; i.e., excessively low or high viscosities.

MEASURED OR CONTROLLED LUBRICATION

Effective lubrication of textile machinery involves, in addition to selection of the proper lubricant, the problem of applying the right amount of lubricant at the right time to each bearing, many of which have their individual needs due to differences in operating conditions. This can be accomplished to a fairly high degree with hand lubrication but only under very close supervision. Even then, because of the human factor involved, hand lubrication still presents the possibility of lubricant waste and stock spoilage due to application of too much

TABLE I

Increase in Single Spindle Power Requirements
Caused by
Change in Speed From 4,000 To 9,000 R.P.M.

Oil Viscosity at 100° F., Saybolt Seconds	*Empty*	*Package Size* 38.5% *Full*	68% *Full*	*Full*
70.8	176%	278%	377%	423%
102.6	173%	248%	330%	379%
183.0	160%	231%	286%	342%

TABLE II

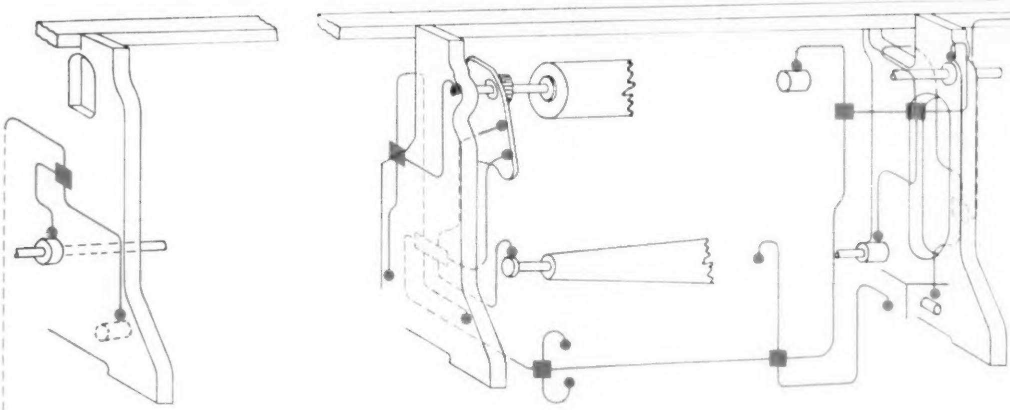
Increase in Single Spindle Power Requirements
Caused by
Change in Package Size From Empty To Full

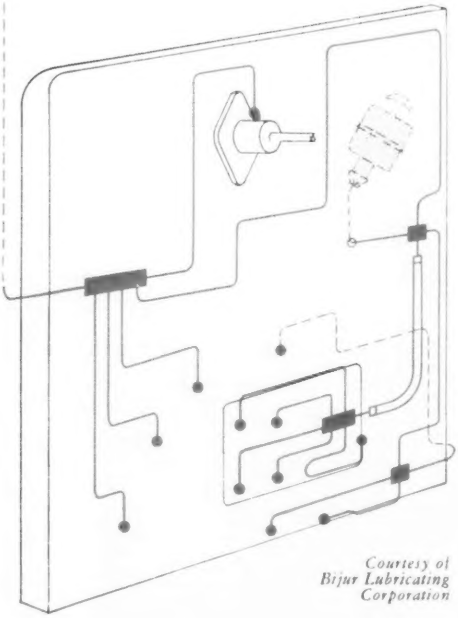
Oil Viscosity at 100° F., Saybolt Seconds	*Spindle Speed, R.P.M.* 4,000	9,000
70.8	39.5%	164%
102.6	35.6%	137%
183.0	28.6%	118%

TABLE III

Increase in Single Spindle Power Requirements
Caused by
Change in Oil Viscosity From 70.8 to 183.0 SSU @ 100°F.

Package Size	*Spindle Speed, R.P.M.* 4,000	9,000
Zero per cent full	47.4%	39.0%
38.5 per cent full	45.0%	27.2%
68.0 per cent full	44.7%	17.0%
100 per cent full	35.9%	14.8%





Courtesy of Bijur Lubricating Corporation

lubricant, or excessive wear due to application of too little or no lubricant at all. In addition, hand lubrication is laborious and time consuming, and necessitates shut-down for safety reasons.

The trend in the textile field today is to get away from hand lubrication wherever possible through the use of centralized lubrication for the application of both oils and greases. Centralized lubrication systems have been installed by many mill operators on various pieces of their existing machinery, and many manufacturers have adopted them as standard or optional equipment on such new machinery as combers, roving frames, spinning frames, twisters, winders, looms, knitting machines, and sewing machines.

Centralizing the Point of Application

Centralized lubrication involves the idea of supplying lubricant in controlled amounts under controlled pressure to many or all the bearings on a machine from a central point of application through pipes. Centralized lubrication systems all consist of the following general set-up:

a. A central applicator which usually involves a lubricant reservoir and a pumping unit for measuring the total amount of lubricant fed to the system.

b. Metering units which are located either on or near the bearings and which proportion the total quantity of lubricant fed to the system in accordance with the individual requirements of the bearings.

c. The necessary connecting piping between the central applicator and the metering units, and between the latter and the bearings.

Operating Procedure

Lubrication by means of these systems is carried out by either manual or automatic periodic operation of the central applicator which may be installed on the machine itself, be located permanently near the machine, or be portable and brought to the machine. In operation, the pump feeds a measured amount of lubricant under pressure to the metering units which automatically proportion the total feed and send precisely measured amounts to the individual bearings.

Some of the advantages to be gained by the use of centralized lubrication instead of hand lubrication are:

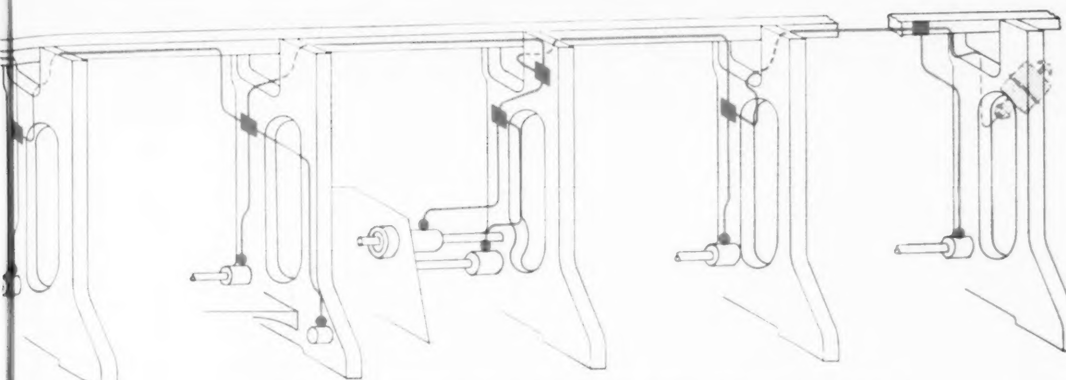


Figure 6 — Details of a Bijur centralized lubricating system on a Saco-Lowell roving frame, serving both head-end and other bearings.

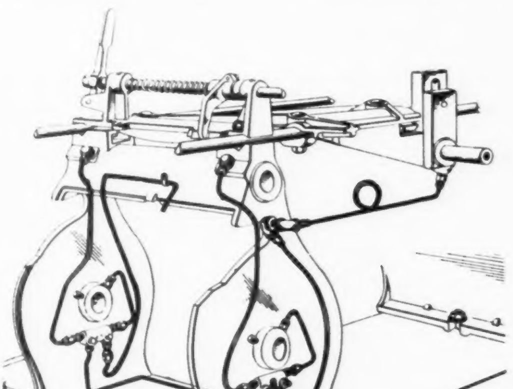
1. Increased production time because the machine can be lubricated while running.
2. Economy of time required for lubrication because all bearings are lubricated from a central point and do not require individual attention.
3. Better lubrication because the possibility of applying too much or too little lubricant, as well as of not applying any at all to some bearings, is minimized; in addition, better distribution of the lubricant is assured when it is applied while the machine is operating.
4. Economy of lubricant because of application of controlled, measured amounts to each bearing.
5. Cleaner lubrication because application through a closed system avoids the tendency to force into the bearings any lint, dirt or grit that has gathered on the outside.

BALL AND ROLLER BEARINGS

Power saving was the primary objective when anti-friction type bearings were originally applied to such textile machinery as opening and cleaning equipment. Other benefits, however, were observed with their use—for example; smoother operation throughout which gave greater life to certain parts and was conducive to higher speed of operation. To derive these benefits in other operations, the machinery manufacturers began to extend the use of such bearings to other textile machines. With the cooperation of the bearing manufacturers application problems have been worked out and, today, anti-friction bearings are in wide-spread use, being found on practically all types of textile machinery. This trend has also been abetted by developments in the bearing industry such as improved bearing designs and the use of better steels and smoother finishes which have added to the dependability of bearings.

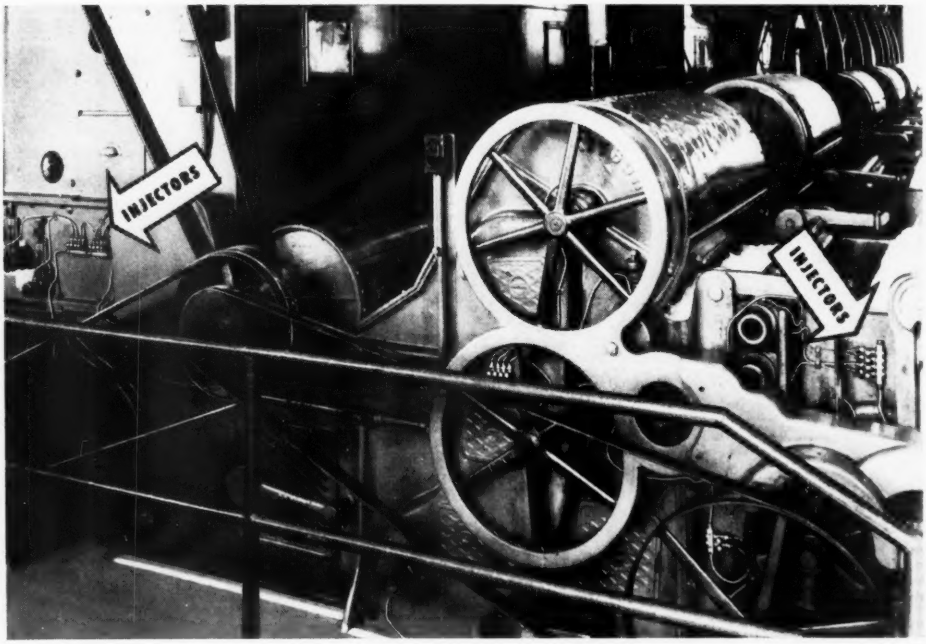
Grease Lubrication Favored

Most of the ball or roller bearings used on textile machinery are grease lubricated, being either



Courtesy of Bijur Lubricating Corporation

Figure 7 — The Bijur "one-shot" oiling system on a Universal No. 45 Winder. Note piping leads to various points from the lubricator.



Courtesy of Lincoln Engineering Company

Figure 8 — A Kitson cotton picker equipped with a Lincoln CentrOiler lubricant application system. This includes a manually operated CentrOiler pump serving 148 bearings.

prepacked or provided with means for pressure grease lubrication. They also are equipped generally with seals to prevent grease leakage and the attendant possibility of stock spoilage, as well as to prevent entry of dust, dirt or other non-lubricating material. Although grease itself is an effective sealing medium if heavy enough in consistency, it is desirable in textile service to employ mechanically sealed bearings, for the use of heavy greases is conducive to abnormal power consumption.

Premium Quality Greases Advisable

The quality of the grease used for lubrication plays an important part in the performance of anti-friction bearings. The ball or roller bearing, like other precision mechanisms, requires the use of a high quality lubricant if the performance expected of it is to be achieved. Practical research and experience in the field of anti-friction bearing lubrication has shown that greases vary appreciably in their performance in such service. To meet the requirements of this type of service the grease must—

1. Be highly resistant to oxidation.
2. Be non-corrosive and essentially free from acid-forming tendencies.
3. Resist separation when subjected to violent agitation and the effect of centrifugal force.
4. Show low tendency for expansion due to air entrainment.
5. Be of suitable texture so that it will not be expelled from the bearing due to pumping action.
6. Develop minimum torque or power consumption on starting and during operation.
7. Have good storage stability; i.e., resist chemical changes during storage.
8. Be relatively easy to apply; i.e., have good pumpability characteristics both at normal and moderately low temperatures.

Obviously, the attainment of these characteristics is not a simple matter. It entails not only the selection of proper quality ingredients for manufacture (oils, soaps and inhibitors) but also development of proper manufacturing procedures for, in grease making, the method of manufacture influences such characteristics as stability, texture, etc. In addition, it involves the evaluation of products in laboratory testing equipment designed to predict performance with respect to oxidation resistance, leakage tendency, torque requirement, lubricating ability, etc. under various conditions of temperature and speed of operation.

Continuing research on the chemical stability of oils and soaps and the use of inhibitors for im-

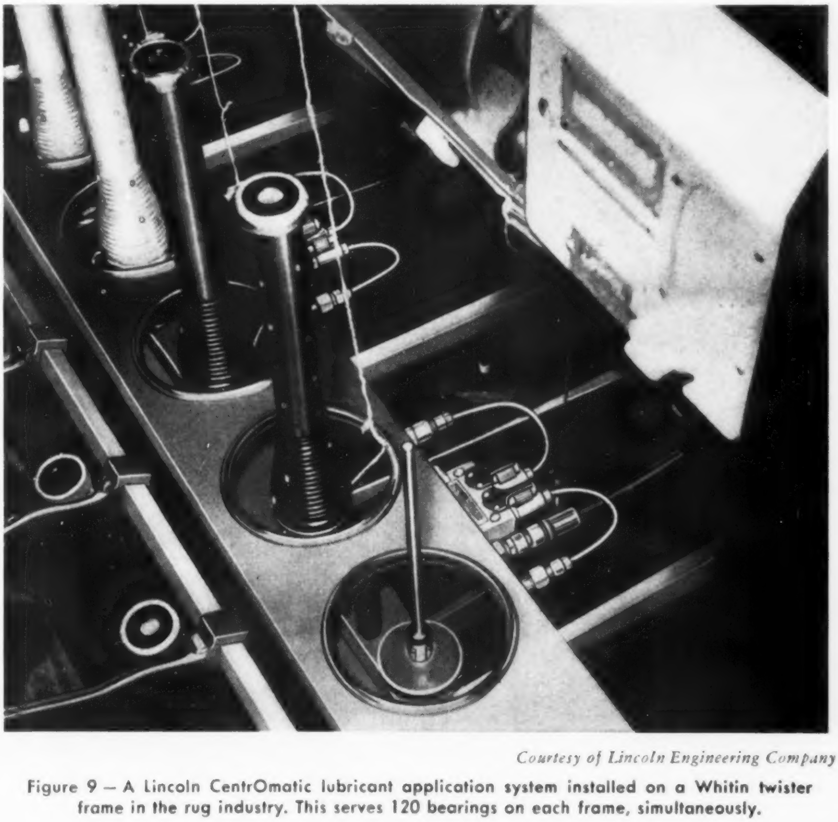
proving the stability of their combinations, along with the use of suitable laboratory grease performance testing equipment, has resulted in the development and production of high quality greases specifically designed for ball and roller bearing service. The use of these high quality products is recommended as it will avoid difficulties such as formation of sticky or hard deposits and corrosion of bearings, all of which are prone to occur with the use of lower quality, cheaper greases. Furthermore, when high quality products are used, re-lubrication will only be necessary on a monthly schedule or at much longer periods, depending upon the design of the bearing and the operating conditions.

A grease compounded from a medium viscosity, highly refined, straight mineral oil, an additive to inhibit oxidation, and a soap suitable for comparatively high temperature service generally will afford satisfactory lubrication and protection to most of the anti-friction bearings found in textile service. Such a grease will resist separation and oxidation effectually and exhibit a satisfactorily low starting and operating torque. There, of course, are bearings that may require the use of a product specifically designed to withstand the particular conditions under which they operate; for example, continuous operation at unusually high temperatures. It, therefore, is advisable for the mill operator to consult his lubricant supplier, the machinery manufacturer, or the bearing manufacturer in regard to the type of product to use for various services.

Method of Application

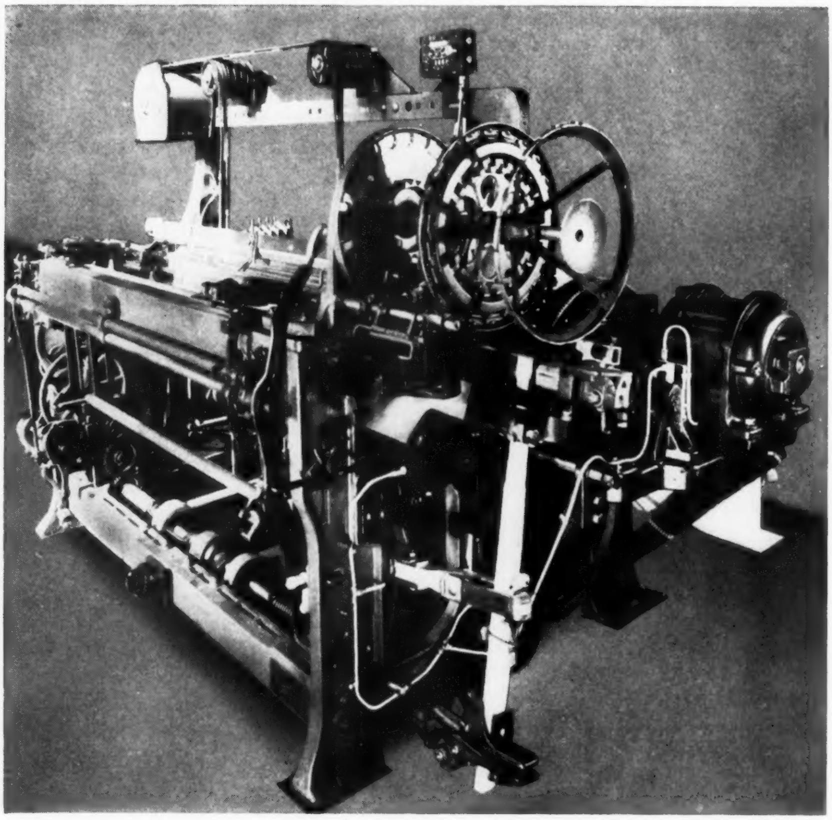
In the maintenance of grease-lubricated anti-friction bearings, the method of application is very important, particularly when relubrication is required. The machinery builders have largely adopted the pressure gun for application of grease to ball and roller bearings, lubrication being accomplished through attaching the gun by means of suitable fittings either located on the bearing housings or connected thereto. This method of application is highly efficient in protecting bearings capable of retaining a grease charge without leakage, but care must be exercised in its use. If the pressure gun is not carefully handled, too much grease can be forced into a bearing housing and operational difficulties, as well as possible damage to seals, may result.

Overfilling may result in overheating due to excessive internal friction within the lubricant itself,



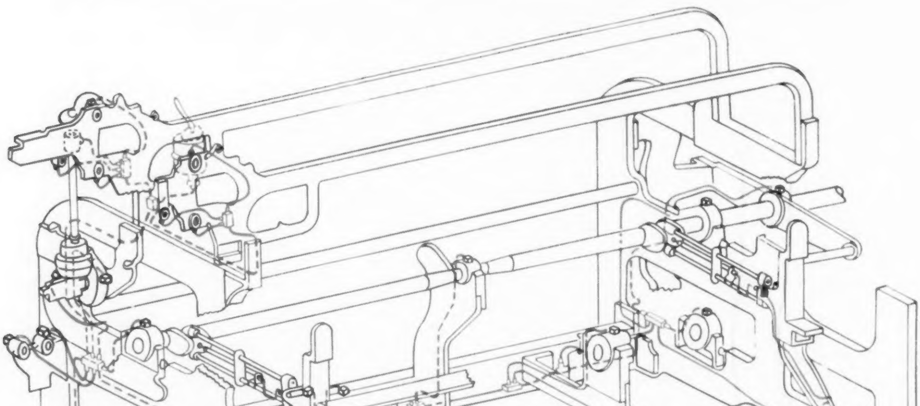
Courtesy of Lincoln Engineering Company

Figure 9 — A Lincoln CentrOmatic lubricant application system installed on a Whitin twister frame in the rug industry. This serves 120 bearings on each frame, simultaneously.



Courtesy of Stewart-Warner Corporation, Alemite Division

Figure 10—Showing application of Alemite Accumeter centralized lubrication to a Draper loom.



Courtesy of Bijur Lubricating Corporation

Figure 11 — Schematic view showing application of piping and fittings of a Bijur centralized system to a Crompton and Knowles W-3 loom. Lines, fittings and points lubricated are shown in red.

particularly if the grease is too heavy. Also, abnormal rise in operating temperature may cause separation of oil from the soap in certain type greases and thus result in marked reduction in lubricating value as well as leakage of oil from the bearing.

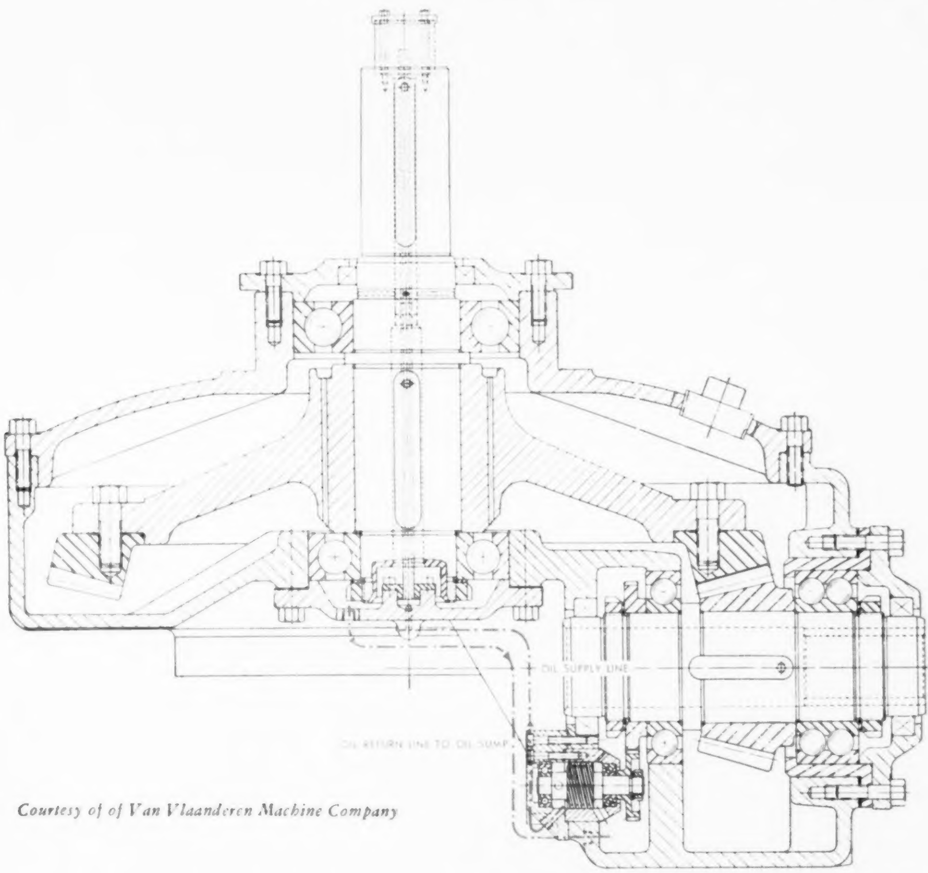
Control in Re-lubrication

Where anti-friction bearings are sufficiently accessible so that they may be safely reached by hand, the operators often judge the need for lubrication by feel; i.e., if a bearing seems to be running too hot, lubrication is required. This is not a truly reliable method of determining the need for lubrication. A bearing may be exhibiting an abnormally high operating temperature due to either already being overpacked with lubricant or the use of too heavy a grease, and the addition of lubricant only aggravates the condition. Operators, therefore, should be carefully educated in regard to the lubrication requirements of ball and roller bearings.

An anti-friction bearing has only a limited capacity for grease but, unfortunately, there is no direct method by which the amount of grease applied to it can be accurately controlled. Certain types of bearings, however, can be vented to reduce the possibility of imposing the full pressure of the lubricating equipment on the seals which, obviously, must be maintained in suitable condition with respect to the housing if they are to effectively prevent leakage of lubricant. To prevent too frequent greasing and avoid careless or wasteful use of the grease gun, it is the practice of some mill operators to use plugs in grease holes instead of pressure fittings and insert the fittings only temporarily at the scheduled time for relubrication.

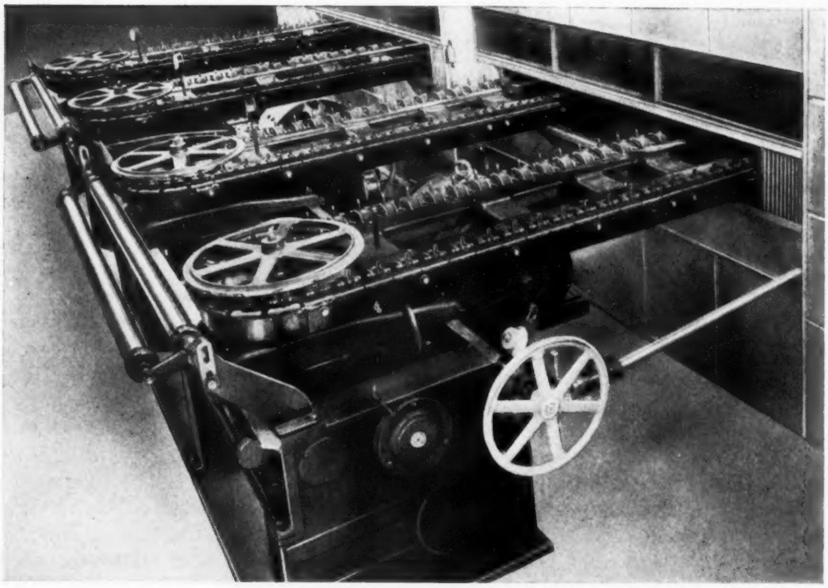
POROUS METAL BEARINGS

Porous metal bearings have been well received by the textile industry. These bearings, which may be made of bronze, iron or aluminum, act like metallic sponges, absorbing and holding a considerable quantity of oil — about 30 per cent by volume.



Courtesy of of Van Vlaanderen Machine Company

Figure 12 — Details of the spiral bevel gear for a Tenter frame. An automatic oil circulating system is built into this unit. Oil supply from pump, and return line to sump are shown in red.



Courtesy of Morrison Machine Company

Fgure 13 — Delivery end of a Tenter frame, illustrating the rigidity and precision required in this type of finishing equipment.

Among the advantages claimed for this type bearing are: Cleanliness
Economy of lubricant
Ease of re-lubrication
Rust and corrosion resistance
Ability to retain oil supply indefinitely

At the time of manufacture porous metal bearings are generally prelubricated by impregnation with an oil which is resistant to oxidation. When re-oiling is necessary, the same type of oil should be used. The use of cheap oils that are not highly resistant to oxidation can result in reducing the effectiveness of these bearings. Such oils are likely to form gummy deposits during service which clog up the capillaries of the porous bearing metal and reduce its ability to give up its oil content. Furthermore, if plugging of the capillaries occurs, the ability of porous bearing metal to absorb oil is reduced and re-oiling can not be carried out effectively.

When re-oiling is necessary, a porous metal bearing in good condition can be fully impregnated by immersion for about fifteen minutes in the proper grade of oil heated to around 140°F. The proper grade of oil, of course, will depend upon the application for which the porous bearing material is employed. In textile sleeve-type bearings, for example, oils having viscosities in the range of from 300 to 500 seconds Saybolt Universal at 100°F. are generally used, although the application of porous bronze to modern spindle bearings permits the use of spindle oil of considerably lower viscosity, commensurate with the speed and size of package.

CONCLUSION

Petroleum became associated with the textile industry some fifteen years before the Drake well. In fact it was back in 1845 that an early researcher found that the oily material from a salt well in Tarentum, Pennsylvania could be combined with sperm oil to form an acceptable lubricant for cotton mill spindles.

From this early record of research there has been continued evidence of the interest of the petroleum scientist in the problems of the textile operator. As spindle speeds were increased spindle oils were studied with relation to stability and power consumption. When ball and roller bearings were adopted, resistance to oxidation in greases became a major objective in petroleum research.

Then the machinery builders contributed. They designed for lubrication. Control of lubrication is an inherent part of machine design and plant maintenance. Controlled lubrication in turn provides mill operators with means of controlling other factors which, unless so controlled might lead to ineffectual lubrication and possibly affect mill production. Time out for maintenance must be kept at a minimum today. This objective can best be attained by studying means and methods of lubrication and by designing machinery to include precision built parts. When machinery failures are forestalled, production schedules are more nearly maintained.

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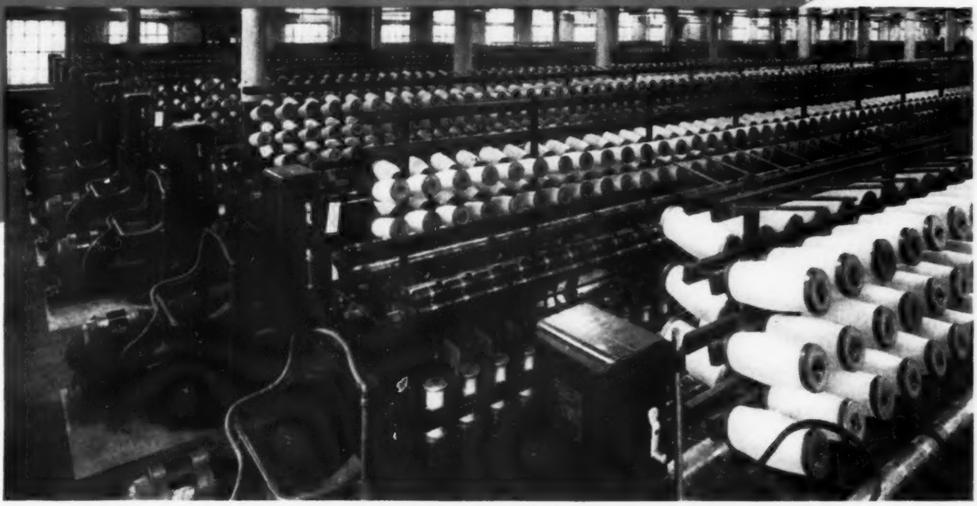

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HERE are the three costs that *Texaco Regal Starfak* – used in your grease-lubricated high-speed ball and roller bearings – will reduce for you: 1) your maintenance costs, 2) your power costs, and 3) your lubrication costs.

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FOR THE TEXTILE INDUSTRY

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